MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

EEL1016 – ENERGY CONVERSION I

(LE)

2 MARCH 2016
230 P.M - 430 P.M
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This examination paper consists of 4 pages with 4 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) (i) Define Power Factor (PF) of an AC electrical power system. [2 marks]
(ii) Briefly explain why the values of Power Factor is in the range of 0 to 1. [3 marks]

(b) Figure Q1 shows a balanced three-phase Y-connected source that has a line voltage, V_{AB} of $208\angle 30°$ volts and feeds two balanced Y-connected loads. The per-phase impedances of the two loads are $Z_{Y1} = 20 + j70\ \Omega$ and $Z_{Y2} = 50 + j30\ \Omega$.

(i) Sketch the per-phase (phase-a) equivalent circuit. [3 marks]
(ii) Find the phase-a voltage at the load side. [2 marks]
(iii) Calculate the power supplied to each load by the source. [8 marks]
(iv) Determine the total Power Factor. [3 marks]
(v) Draw the phasor diagram of phase-a currents and voltage. [4 marks]

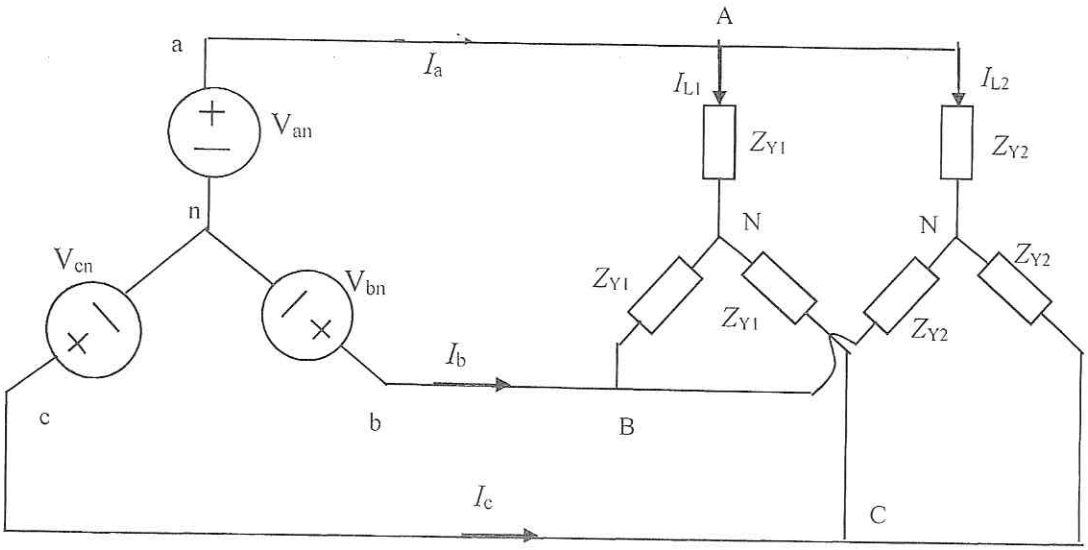

Figure Q1

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Question 2

(a) Figure Q2 shows an equivalent circuit of a 5000-kVA 230/13.8-kV single-phase power transformer, where the primary parameters have been transferred to the secondary. Given that the secondary voltage is 13.8 kV, and the power supplied is 4000 kW at 0.8 PF lagging,

(i) calculate the voltage regulation of the transformer. [10 marks]
(ii) determine the efficiency of the transformer. [7 marks]

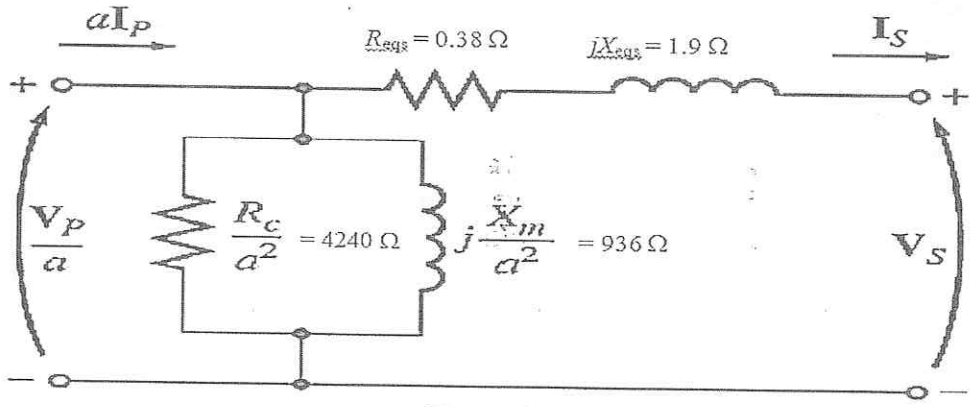

Figure Q2

(b) (i) Briefly explain why a testing of transformer is required. [2 marks]
(ii) Name the types of the transformer testing and the parameters that can be obtained from the testing. [6 marks]

Question 3

A 380-V, 50-Hz, six-pole Y-connected wound motor induction motor is rated 95 kW. Its equivalent circuit components are:

$R_S = 0.082\ \Omega$ $R'_R = 0.07\ \Omega$ $X_M = 7.2\ \Omega$ $X_S = 0.190\ \Omega$
$X'_R = 0.18\ \Omega$ $P_{mech} = 1.3$ kW $P_{stray} = 150$ W $P_{core} = 1.4$ kW

For a slip of 0.03,
(a) Sketch the approximate equivalent circuit [3 marks]
(b) Use the circuit in part (a), find the
(i) magnetizing core resistance R_C [2 marks]
(ii) line current and power factor [9 marks]
(iii) air-gap power [2 marks]
(iv) developed power [2 marks]
(v) overall machine efficiency [7 marks]

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Question 4

A four-pole, 440-V, 50-Hz three-phase Y-connected synchronous machine has a rating of 10-kVA, negligible stator winding resistance and a three-phase synchronous reactance of 42 Ω at rated terminal voltage is first operated as a generator in parallel with a three-phase, 440-V, 50-Hz power supply.

(a) Determine the excitation voltage and the power angle if the machine is delivering rated kVA at power factor of 0.85 lagging. [7 marks]

(b) By keeping the prime-mover power fixed and the field excitation current increases by 10%, find the stator current, power factor, and reactive kVA supplied by the machine. [10 marks]

(c) With the field current as in (a), the prime-mover is slowly increased. What is the steady-state stability limit? What are the corresponding values of the stator current, power factor, and real power at this maximum power transfer condition? [8 marks]

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